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The Effect of Activation Policies on Accession and Continuation in the Army Reserve Components

The Annualized Reserve Component Activation Cost of Leaving Model

Colin Doyle, Project Leader

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PREFACE

This document reports the work performed by the Institute for Defense Analyses (IDA) for the Office of the Assistant Secretary of Defense (Reserve Affairs) in partial fulfillment of the task entitled "RC Activation Capacity."

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CONTENTS

SUMMARY

This paper examines how policies on mobilization, personnel management, and compensation affect the decision to join the Army Reserve Components (RC) and the decision to continue in service. We derive and estimate a behavioral model of these decisions, which may be employed to predict the manpower consequences of alternative policies. The work was undertaken in the context of the unprecedented mobilization of large numbers of reservists and guardsmen that has taken place subsequent to the attacks of September 11, 2001. This extensive mobilization has raised concerns that widespread extended tours of active duty might reduce the retention of service-members and the supply of new recruits to the Reserve Components. Sophisticated theoretical models of the accession (joining) and retention decisions of Active component soldiers have been developed and tested. Until recently, there has not been a corresponding development of the theory of RC participation; we develop such a model.

Our model is a multi-period discrete choice model, meaning that reservists choose whether or not to stay in the selected reserve in each year of service. Reservists make forward-looking decisions based on their expectations about pay and mobilizations. The negative or beneficial effects of mobilizations vary across individuals according to a statistical distribution. We statistically estimate the parameters of this distribution using the choices made by Army RC enlisted members who joined between 2002 and 2007. We extend the model to analyze the decision to join the reserve components.

Our results indicate that while the great majority of the population of young men is disinclined to serve in a mobilized condition, an important minority will perceive mobilizations positively. Accessions and continuation rates are sensitive to the frequency and duration of active duty. Plausible increases in expected active duty will result in relatively small reductions in continuation rates. Pay and bonuses have the capacity to reverse these losses. By contrast, accession rates will increase with reasonable increases in demand for active-duty time above current levels.

A. INTRODUCTION

During the ten-year period between Operation Desert Shield/Storm and September 11, 2001, few military reservists were ever involuntarily called to active duty. Even within units that were called up "involuntarily," volunteers from other units commonly replaced those members who did not wish to mobilize. This pattern changed dramatically following the terrorist attacks of September 11, 2001. During the subsequent Global War on Terror (GWOT), hundreds of thousands of members of the Army National Guard and Reserve have been activated; 73,769 reservists were currently on active duty as of February 13, 2008 (Department of Defense, 2007a). Consequently, the extensive use of reserve forces has raised concerns that retention and/or recruiting in the Reserve Components might decline.

Recent statistical studies of the effect of deployment on the retention of Active Component members have indicated that deployment may actually increase retention (see Cook, Marcus and Quester, 1992; Hosek and Totten, 1998; Fricker, 2002). However, these studies relied on data from the period prior to the war on terror. Future statistical studies based on data from the current wartime period may be correspondingly inapplicable to peacetime deployments. It is also unknown whether these results extend to the Reserve Components. These issues highlight the need for understanding the determinants of recruiting and retention in the Reserve Components. Sophisticated statistical models of the accession and retention decisions of Active Component soldiers have been developed and applied to data. Until now, there has not been a corresponding development of the theory of reserve participation.

Dolfini-Reed, Parcell, and Gregory (2005) have presented data on the rates at which activated and never-activated reservists remain in service from year to year. These are important findings. However, a forward-looking decision to continue in service will be affected by expected future activation as well as past active duty. Comparing these reported continuation rates cannot elucidate whether expected activation alters continuation. Only a small fraction of second activations in support of the GWOT have been involuntary. The partial mobilization authority (Title 10 U.S.C 12302) requires that no reservist be activated longer than twenty-four months. Therefore, during the early years of the GWOT, the Department of Defense did not activate reservists involuntarily a second time if they have already served more than twelve months of active duty.

Consequently, reservists who had already been activated may have had an expectation that they would not be activated again under the current authority.[1] If they hold these expectations, even if reservists view active duty negatively, the activated group need not have a lower continuation rate than the never-activated group. This is true because some activated reservists will stay because they do not expect more active duty, while some never-activated reservists will leave to avoid future activation. Future expectations of active duty are important in today's continuation decision. We have developed a model that accounts for these expectations.

We have pursued a four-stage research program. In stage one, we formulate a mathematical model of the accession and continuation decision. The second stage is to apply this model to statistically estimate the structure of attitudes to active service among reservists and among the general population. The goal of stage three is to use the populations found in stage two to build a forecasting model that will predict changes in the strength of the Reserve Components as expectations of active duty change. Finally, stage four involves using the forecasting model to simulate the effects of alternative policies on Reserve Component strength.

This paper reports the results of stages one and two of our research agenda. We present a model of the decision to stay in the Selected Reserve in each year (continuation). These decisions are affected by the frequency and durations of involuntary periods of active duty, the predictability of involuntary call-up, and the level of pay and bonuses. We extend the model to explain the decision to join the reserves (accession). We use statistical methods to match this model to the behavior of the true population of young males. Ultimately, this decision model will form the basis of a forecasting model. Forecasts will vary with policies on mobilization, personnel management, and compensation. The forecast model will also predict the tradeoffs between these factors.

B.   A MODEL OF RESERVE SERVICE DECISIONS

Our model is an extension of the widely used "augmented Annualized Cost of Leaving" model or ACOL-2 (see Goldberg, 2001). In keeping with tradition, we term our model the Annualized Reserve Component Activation Cost of Leaving Model, or

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[1]   The recent announcement (Department of Defense, 2007b) of a change in this policy involving a switch to a rotational system of activations, and the possibility of second call-ups for some reservists, must have now altered expectations.

"ARCACOL." This is a model of the decisions to join and continue in service. Reservists make forward-looking decisions. They compare the benefits from not joining the Selected Reserve at the current time with the benefit from joining and staying until retirement eligibility. In subsequent years, they compare the benefits from leaving the Selected Reserve in the current year with the benefit from staying until retirement eligibility. They decide in each year whether to stay or leave.

We assume that reservists understand the national security environment when they form their expectations. They know that there is always some probability of a war, and that activations will occur in wartime. Reservists do not know with certainty whether next year will be wartime or peacetime; they do not know whether they will be activated next year. However, they know the probabilities of these events. Wartime is divided into two possible levels of engagement: a heavily engaged state in which our military is involved in several wars at once (as it has been since 2003) and a state of more limited involvement. We assume that reservists expect that activation rates during the highly engaged state will be similar to those of the current Global War on Terror era.

Three factors affect reservists' decisions to join, and to stay in, the Reserve Components. Reservists value money income. They care about the amount of time that they spend on active duty, and assign a positive or negative money valuation to a day on active duty. Random events also affect reservists' decisions; for example, a spousal illness may raise the "cost" of service temporarily. These random shocks are also expressed in dollar terms; they are added to income and the valuation of active duty, giving a total measure of "utility"—the reservist's well-being. A reservist decides whether to stay or leave the Reserve Components by comparing the sums of the discounted values of utility generated by the two options.

Money income is composed of military pay, reserve retirement pay, and average civilian earnings. Military pay consists of the following:

1. Inactive-duty pay
2. Active-duty Regular Military Compensation
3. Expected military retirement pay
4. All recruitment and retention bonuses available to a particular service member

Civilian earnings depend on general labor market experience measured by age. Civilian earnings will not be earned while on active duty. Permanent income effects that

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are not measured, such as variations in civilian pay, will be captured in the value of active duty.

The relationship between active duty time and the reservists' utility (their well-being) has two important features. First, the relationship is non-linear: a service member who would prefer six months of active duty to no active duty might also prefer no active duty to eighteen months. Second, reservists' past history of time spent on active duty affects the decisions they make today. A reservist's valuation of active duty time for his current utility includes both the number of months on active duty this year *and* the number of months in prior years. The effect of active duty in prior years on current utility grows smaller as the years recede. This formulation reflects the idea that time spent away on active duty affects the quality of one's home life in durable ways. For example, a marriage may be more resilient to a one-year absence than a three-year absence. Activation this year may be harder on a family if the reservist has also been activated in a recent year.

Finally, the key feature of the model is that the relationship between active duty and utility is different for each person. The model assumes that people's attitudes follow a statistical distribution along the axis from active duty being more beneficial to active duty being more costly. Some people may prefer no active duty, while others may prefer to have some active duty but not too much time away from home; still others may prefer to be full-time on active duty.

C. ESTIMATION

1. Data

We estimated the parameters of our model using data covering all service members with no prior military service who enlisted in the Army Reserve and Army National Guard from 2002 through 2007. We restricted our sample to those males joining the reserves at age 18 and observed the choices made by these 68,153 individual soldiers.[2] The data were provided by the Defense Manpower Data Center; records were drawn from personnel files and from a data set of activations in support of the Global War on Terror, the Contingency Tracking System. Our measures of pay were derived from Census Bureau tabulations of civilian income, military pay tables and records of the

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[2]   We are currently working to extend the model to prior-service recruits. As of September 2007, at least 55 percent of Army Selected Reserve members had no prior active Army service.

total bonuses paid to reservists each year. The latter was provided by the Office of the Assistant Secretary of Defense for Reserve Affairs.

Officially, recruits without prior service incur a 6-year Selected Reserve service obligation during which they are ineligible to leave. In reality, the observed rates of continuation in the first to the fifth year of service are well below 100 percent, with roughly 15 percent of the population leaving the Selected Reserve from year to year. The Army Reserve Components do not appear to enforce the obligation to stay. Therefore, we applied no obligation in our estimations and we are modeling continuation rather than modeling retention. *Retention* is a term usually associated with decisions made at the end of a service obligation.

2. Methodology

Our model relates the probability of staying in the current year to the money cost of leaving and to expected future active duty. The expected future active duty that enters into the model depends on two "rules" that we have estimated from our data. The first rule governs the transition from peacetime to wartime and back. The second rule captures the effective policy determining reservists' history of active duty during wartime.

The first rule is demonstrated in Figure 1, which presents the probabilities of moving between peacetime, limited wartime and heavily engaged wartime. The figure shows that during a peacetime year there is a 9.9 percent chance of moving to limited war the following year, a 21.3 percent chance of moving to heavily engaged war, and a 68.8 percent chance of remaining in peace. We estimated these probabilities from the series of wartime and peacetime years from 1973 to 2007.[3]

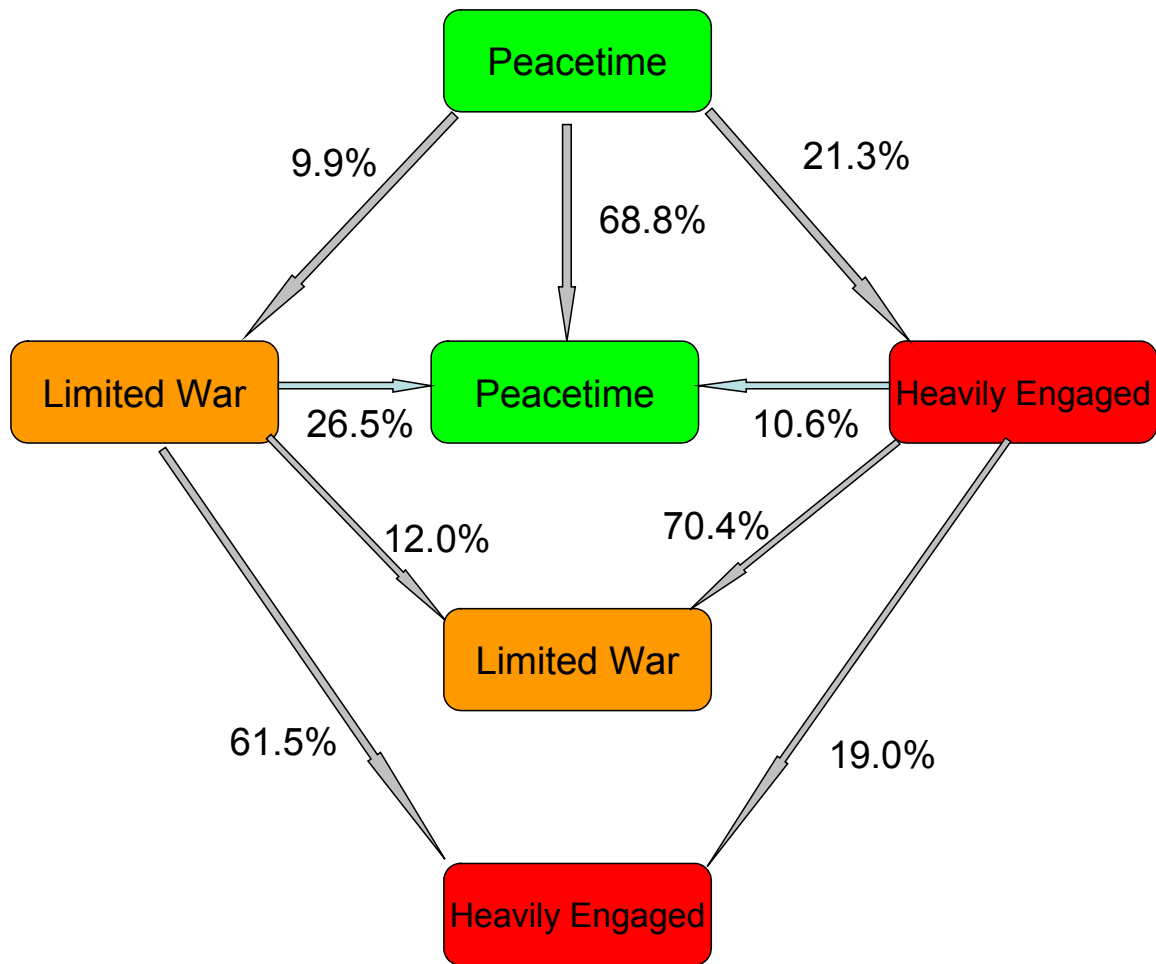[3] The choice of these dates is discussed in the appendix.

Figure 1. Probabilities of Moving Between Peace and Wartime

The activation rule is estimated from our data on the activation histories of the reservists in our sample. The rule provides for a reservist to have activations alternating with periods of time at home (dwell times). The lengths of these activations and dwell times are chosen randomly from the distribution of these lengths in our data. This distribution is illustrated in Figure 2. For example, 13 percent of activations were for 12 months. The rule assigns a 13 percent chance to an activation having a length of 12 desired policies in place at the time.[4] In practice, soldiers in different Army Career

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[4]   Our dataset does not allow us to determine whether a given activation was truly voluntary or involuntary. Our model implicitly assumes that all activations are involuntary. If, as is likely, some of the activations that we have observed in our data are voluntary, our activation rule will overstate the amount of active duty time that a reservist can expect to be required to serve. This possibility presents a major caveat to our work and may bias our results.

Management Fields (CMF) experience different rates of activation. We allow for the rule to vary with CMF.
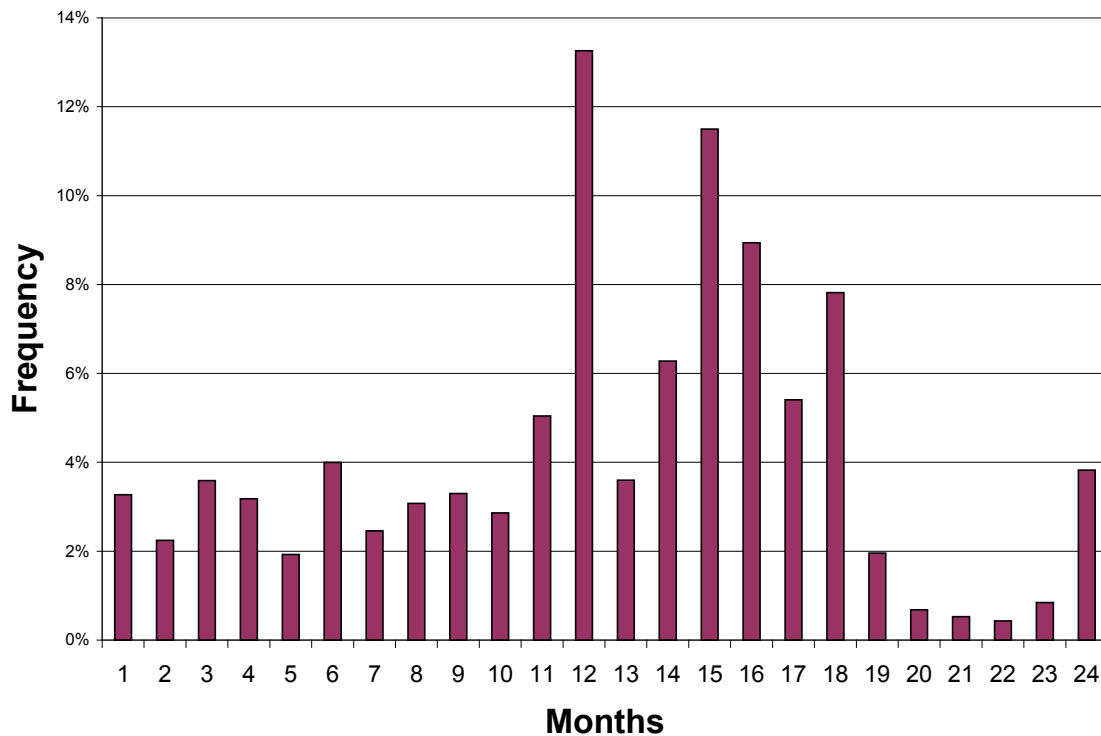
Figure 2. Distribution of Activation Lengths

Reservists use the two rules to make predictions of how much active duty they can expect, and they assign an equivalent money value to these amounts. They will stay if the sum of this money equivalent, the expected value of pay, and the measure of random events is positive. We statistically estimate how much each reservist values differing amounts of active duty. Our econometric model, described fully in the appendix, produces a distribution of reservists along a spectrum of low to high "tastes" for active duty. The decision to join the Guard or Reserve follows the same principle. In the joining stage, people face three choices: do not join, join the Army Guard/ Reserve, or join the active Army.

D.   RESULTS

Our results allow us to analyze the continuation decision in the first year of service.   We first illustrate the variation of tastes. Figure 3 presents probabilities of continuation for three individuals. The "middle" member has the median taste for active

duty, the "high" individual has a greater taste than 75% of members and the "low" individual has a lower taste than the higher 75%. The middle person has a good chance of continuing when faced with up to 5.5 years spent on active duty during his career, but his chances of staying decline rapidly as demands rise beyond that. The "low" member tends to drop out when expecting more than 4.5 years away. The "high" member has a strong taste for active duty. We might have expected such a person to have joined the regular Army. Our joining model allows for some other factor to have influenced him to join the reserves.
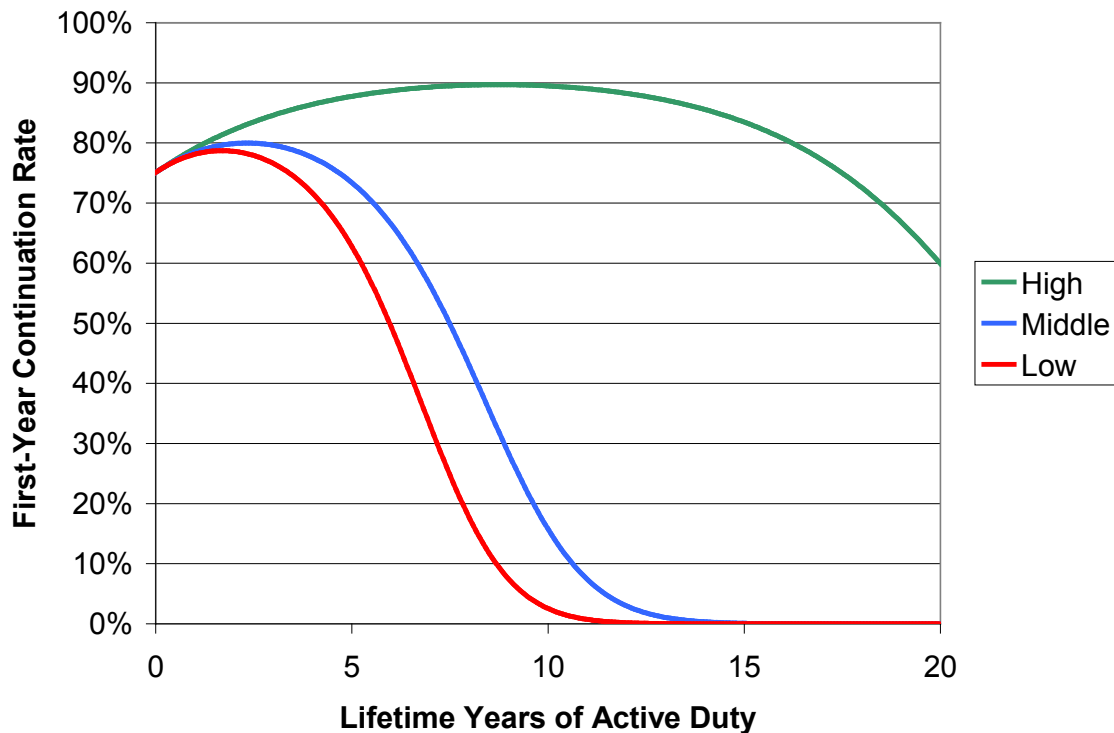
Figure 3. Continuation Rates for Individual Reservists

We can now generalize these results to the entire population of reservists. The sum of these individual decisions results in a continuation profile for the whole force, which is illustrated in Figure 4. The blue line represents the first year of service continuation rate for each level of lifetime active duty. Continuation is maximized when reservists expect about 2.6 years of active duty during their career. The continuation rate falls below 70 percent when lifetime active duty exceeds 5.7 years. The expectation based on the current war environment is about 4 years. Increases in pays and bonuses can

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alter this profile, increasing continuation. The red line demonstrates what the relationship between active duty and continuation would look like if an additional reenlistment bonus of $2,000 were offered, payable at the fourth year of service. Continuation rates are increased by about 6 percentage points. Alternatively, the same continuation rate can be had with an additional 2 years of active duty.

Figure 4. First Year of Service Continuation Rates
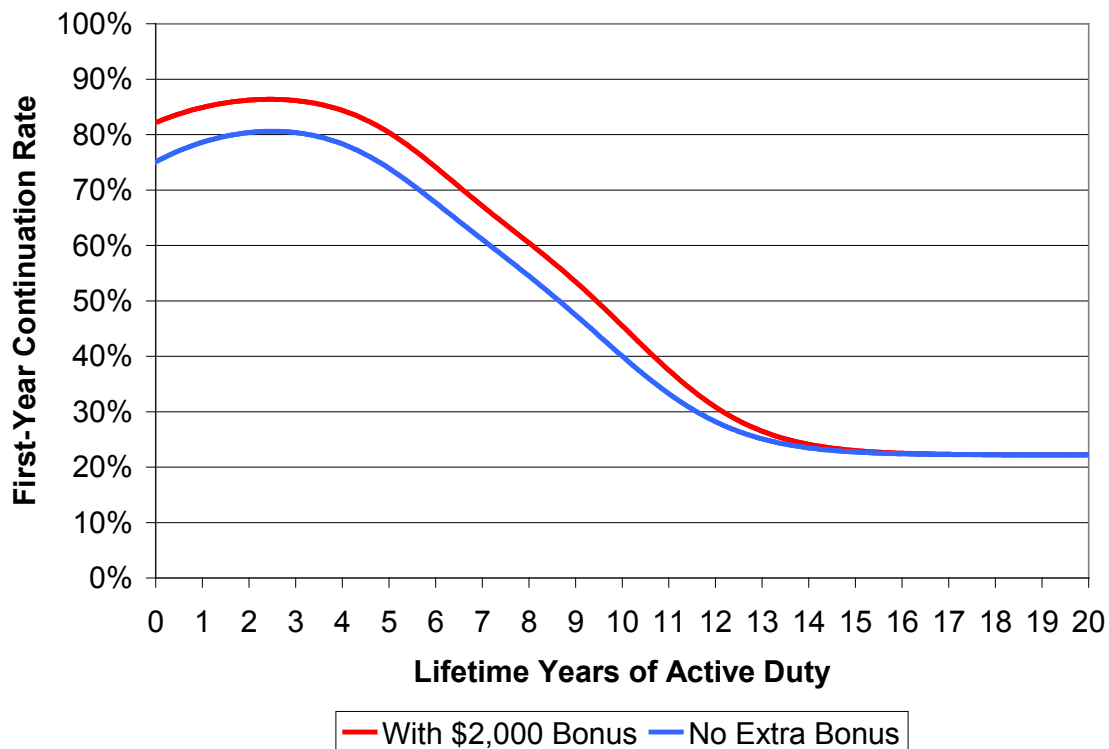
Figure 4. Continuation Rates With and Without Bonus

The number of new accessions will also be affected by the total of lifetime active duty. Figure 5 illustrates the numbers of accessions for each level of active duty. It is important to note that true accessions will also be influenced by the Army's recruiting goals; these numbers may be thought of as the pool of potential recruits. The blue line represents the effect of active duty on accession under current benefits. Accession is maximized when the population expect about a quarter of lifetime service to be spent on active duty. We can also analyze the effects of pays and bonuses on these numbers. The

red line in Figure 5 plots levels of accession generated with an additional $2,000 recruiting bonus. The bonus generates about a thousand additional recruits at current levels of active duty.
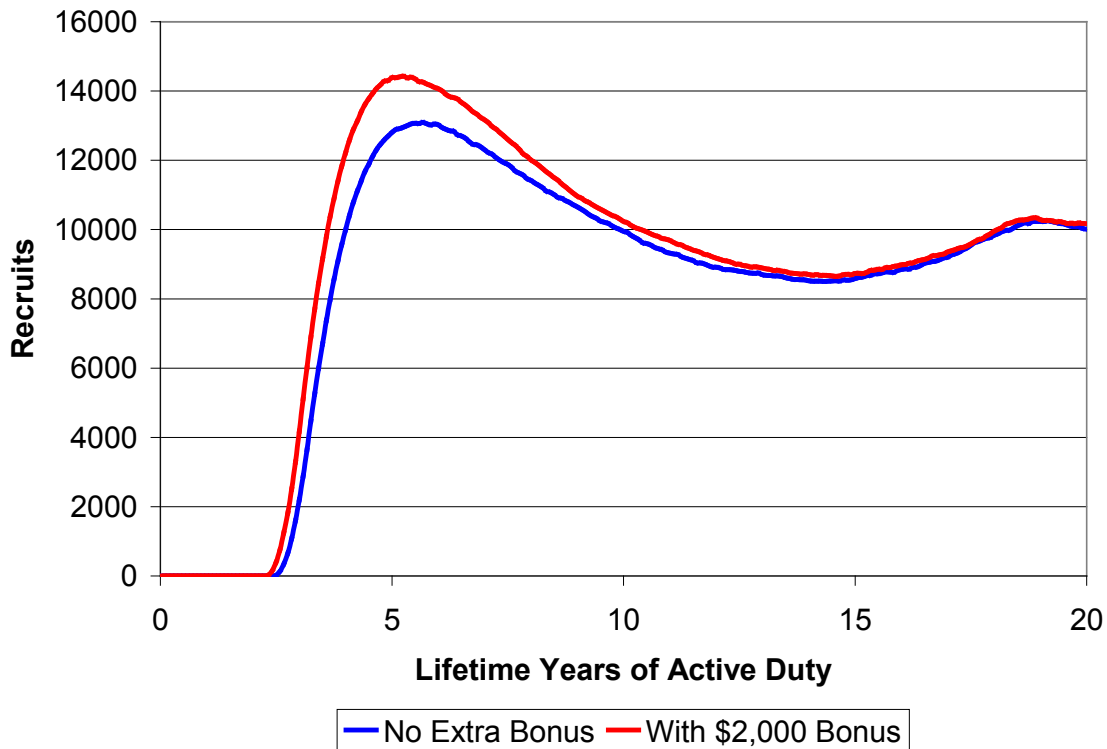
Figure 5. Accessions With and Without Bonus

By definition, these results do not tell the whole story. Changes in activation rules will affect the composition of the force. When expected active duty increases, those with low taste will choose to leave or will not join. Those with high taste will stay at higher rates and will join the reserves at higher rates. Over a period of years, the resulting force will have a greater attachment to service. Our forthcoming projection model will address these issues.

E.   CONCLUSION AND NEXT STEPS

We have estimated a model of reserve participation that accounts for expectations and varying tastes for active-duty service. Our model demonstrates that accessions and continuation rates are sensitive to the frequency and duration of active duty. Plausible increases in expected active duty will result in relatively small reductions in continuation

rates. Pay and bonuses also have the capacity to reverse these losses. By contrast, accession rates will increase with reasonable increases in demand for active-duty time above current levels. We should note that we cannot know if our estimates generalize to the prior-service population or to the other Reserve Components. In fact, we would expect that the results for these groups might differ significantly. We are currently in the process of estimating our model for an Army prior-service population.

Our research program continues with the development of an inventory projection model that accounts for the full distribution of tastes that we have estimated. This model will forecast the numbers of young men joining the Reserve Components and the numbers of these men continuing in service at each subsequent year. The model will forecast the effects of given activation rules. It will forecast the changes in strength during the transition between war and peace. Finally, the projection model will forecast the changes in strength during the transition between different activation policies.

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Appendix
THE ANNUALIZED RESERVE COMPONENT ACTIVATION
COST OF LEAVING MODEL

A. THE DETERMINANTS OF ACTIVE-DUTY TIME

The national security environment can be either "wartime" or "peacetime," and it changes from year to year. The transitions between these states follow a known Markov process, with a transition matrix W. For example, if we estimate a Markov model on the years since the American Revolution,[1] we find the transition matrix to be

$$W = \begin{pmatrix} p(peace|peace) & p(war|peace) \\ p(peace|war) & p(war|war) \end{pmatrix} = \begin{pmatrix} .9321 & .0679 \\ .2185 & .7815 \end{pmatrix}.$$

The elements of the matrix are the probabilities of peace (or war) occurring next year given a state of peace (or war) this year. The matrix gives a probability of 93.21 percent for the transition from peace to peace, 6.79 percent for the transition from peace to war, 21.85 percent for the transition from war to peace, and 78.15 percent for the transition from war to war. If this Markov process is applied to a long series of years, the result is a "steady state" in which 24 percent of history is spent in a state of wartime and 76 percent of years are characterized as peacetime.

In our model, each year can be characterized as "limited wartime," "heavily engaged wartime," or "peacetime." In a limited wartime year, the reservist faces some probability of involuntary mobilization. In a time of heavily engaged war, the reservist faces a higher probability of involuntary mobilization. In a peacetime year, the reservist has no chance of involuntary active duty. We assume that people expect heavily engaged wartime mobilization rates will be similar to those of the current Global War on Terror (GWOT) era (post-9/11/2001). This includes the wars in Iraq and Afghanistan. In a period of lower-intensity wartime, the reservist will expect to be called up for an average of once in 6 years, without knowledge of the timing of these activations.

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[1] We designate the years of the War of 1812, the Civil War, the Spanish American War, World War I, World War II, the Korean War, the Vietnam War, the Gulf War, and the current GWOT era (2002-2007) as wartime.

We have estimated this three-state Markov process on the years of the all-volunteer force (1973 to 2007). We consider the Gulf War and the post-9/11 years to be "heavily engaged wartime" and the years of the interventions in Grenada, Panama, Bosnia, and Kosovo to be "limited wartime." The resulting transitions are given below.

$$W = \begin{pmatrix} p(peace|peace) & p(ltd|peace) & p(heavy|peace) \\ p(peace|ltd) & p(ltd|ltd) & p(heavy|ltd) \\ p(peace|heavy) & p(ltd|heavy) & p(heavy|heavy) \end{pmatrix} = \begin{pmatrix} .6876 & .0992 & .2132 \\ .2649 & .1201 & .6150 \\ .1058 & .7041 & .1902 \end{pmatrix}$$

The steady state years are 38.5 percent peace, 34.6 percent limited war, and 27 percent heavily engaged war. In order to compare this steady state with the one we generated from the long historical series, we liken major wars to the historic wartime state and consider minor wars to fall under the historic peacetime state. We implicitly treat minor wars as peace years in our long historic series. The resulting steady state is close to the one we generated from our long series.

During the wartime states, the lengths of a soldier's activations follow a known probability distribution. His dwell times between activations will be determined by another distribution. We assume that in the event of either heavily engaged or limited wartime, activation lengths will be distributed as they have been during the years 2003–2007. We estimate separate distributions for 14 Career Management Fields (CMF) and one for all CMFs taken together. In heavily engaged wartime, the dwell times will also follow recent history. In our sample period, many of the post-activation dwells were censored at the end of our time frame; that is, there had not been a subsequent activation as yet. In order to handle this issue, the distribution of dwell times was assumed to follow a normal distribution, and the parameters of this distribution were estimated by a censored data regression. The resulting distribution has a mean of 47 months and a standard deviation of 27 months. Again, we also compute the distributions separately for 14 CMFs. During limited war, dwell-times follow a distribution with the same variance but a mean of 60 months. We are thus assuming that during limited wartime, the Department of Defense can meet its goal of activating reservists once in every 6 years on average.

By combining the random process for transitioning between war and peace with random draws for first and subsequent amounts of active duty and dwell time, we produce our "activation rule." This rule reflects the current reality rather than the policy goal.

B.   THE DECISION PROCESS

Reservists' utility is determined by three factors: income, the money-equivalent utility of time spent on active duty, and random disturbances. Past active-duty time matters in today's utility. The depreciated active-duty time is given by

$$A_t\left(H^i\right) = \sum_{s=0}^{t} \kappa^s a_{t-s}^i$$

where a_t^i is 1 if individual i with a particular history of active duty (denoted H^i) serves on active duty in month t and

$$0 < \kappa < 1$$

The parameter κ is a depreciation factor. It measures the extent to which last month's active-duty time enters into today's utility.

For notational simplicity, we denote

$$A_t^i \equiv A_t\left(H_t^i\right)$$

The one-period utility function measures an individual's well-being in the current month. It is given by

$$u(t,i) = \alpha_0' + \alpha_m m_t + \alpha_1 A_t^i + \alpha_2 \left(A_t^i\right)^2$$

where m_t is money income, which includes both military and civilian income. Civilian income is not earned during active duty. The utility function is linear in money income, which ensures that people are risk-neutral in money. The parameters α_m, α_1, and α_2 describe an individual's unique utility function. The utility function is quadratic in accumulated active-duty time. This formulation allows active-duty time to have declining marginal utility. If this is the case, any gain in utility from a second month on active duty will be less than the gain from the first month; alternatively, any loss in utility from a month on active duty will be greater than the loss from the prior month. If the marginal utility of active duty is declining, people will be risk-averse in active-duty time. Variation in preferences across individuals is modeled as variation in α_2. We assume that α_2 follows a normal distribution:

$$\alpha_2 \sim N(\mu, \sigma)$$

Individuals care about their well-being in future years. They measure lifetime utility as the discounted present values of each future month's one-period utility. For an

individual at the present time t, the expected return to staying until a future time T is given by

$$U_T(t,i) = E_t\left(\sum_{\tau=t}^{T} \beta^{\tau-t} u(\tau)\middle|i\right) = E_t\left(\sum_{\tau=t}^{T}\left(\beta^{\tau-t}\alpha_0' + \beta^{\tau-t}\alpha_m m_t + \beta^{\tau-t}\alpha_1 A_t + \beta^{\tau-t}\alpha_2\left(A_t^2\right)\right)\middle|i\right)$$

where β is the discount factor for the present value calculation. $E_t(\ )$ is the expectations operator, capturing the individual's forecast of the future at present time t. It follows that

$$U_T(t,i) = \alpha_0'' + \alpha_m \sum_{\tau=t}^{T}\left(\beta^{\tau-t} E_t\left(m_\tau\middle|i\right)\right) + \alpha_1 \sum_{\tau=t}^{T}\left(\beta^{\tau-t} E_t\left(A_\tau\middle|i\right)\right) + \alpha_2 \sum_{\tau=t}^{T}\left(\beta^{\tau-t} E_t\left(A_\tau^2\middle|i\right)\right).$$

The values of $E_t\left(m_\tau\middle|i\right)$, $E_t\left(A_\tau\middle|i\right)$ and $E_t\left(A_\tau^2\middle|i\right)$ are determined by the activation rule. $E_t\left(m_\tau\middle|i\right)$ is the expectation at present time t of money income at future time τ.

We now define

$$U_T^2(t,i) = \frac{U_T(t,i)}{\sum_{\tau=t}^{T}\left(\beta^{\tau-t}\right)} = \alpha_0 + \alpha_m ACOL_T + \alpha_1 S_{T1} + \alpha_2 S_{T2}$$

where

$$ACOL_T = \frac{\sum_{\tau=t}^{T}\left(\beta^{\tau-t} E_t\left(m_\tau\middle|i\right)\right)}{\sum_{\tau=t}^{T}\left(\beta^{\tau-t}\right)}$$

$$S_{T1} = \frac{\sum_{\tau=t}^{T}\left(\beta^{\tau-t} E_t\left(A_\tau\middle|i\right)\right)}{\sum_{\tau=t}^{T}\left(\beta^{\tau-t}\right)}$$

$$S_{T2} = \frac{\sum_{\tau=t}^{T}\left(\beta^{\tau-t} E_t\left(A_\tau^2\middle|i\right)\right)}{\sum_{\tau=t}^{T}\left(\beta^{\tau-t}\right)}$$

The variable $ACOL_T$ is the money cost of leaving the service, expressed as an average annual amount. The variable S_{T1} is a measure of the number of depreciated months of active duty that the individual can expect to enter into an average month's utility during his career. If the value of κ is zero, meaning that past active-duty time does not matter in today's decision, the value of S_{T1} captures the proportion of his reserve career that an individual can expect to spend on active duty. Then, S_{T1} will lie between zero and one.

When κ is positive, meaning that active-duty time accumulates, S_{T1} can take on values greater than one. If κ is equal to one, than S_{T1} is a discounted measure of the total time that the reservist expects to spend on active duty during his career. In this case, it is a simple matter to convert S_{T1} to an undiscounted measure of the total amount of active duty in a career. Our estimation, described in the next section, determined that κ is indeed equal to one. The variable S_{T2} measures the square of the active-duty months entering an average month's utility. We present examples of the explanatory variables in Table A-1. The table contains the values of S_{T1}, and S_{T2} at the first year of service with no history of activation, reported by CMF. In our estimation, these values also vary by year of accession, year of service, and history of active duty.

An individual will choose to stay at time t if his expected lifetime utility from staying is positive:

$$U_T^2(t,i) + \varepsilon > 0$$

T is the expected date of retirement eligibility, and ε is a random variable drawn from the logistic distribution.

Table A-1. Examples of Explanatory Variables

Army Career Management Field	S_{T1}	S_{T2}
All	6.8245269	143.34444
11 Infantry	8.0660619	177.33848
13 Field Artillery	7.2082535	151.53744
15 Aviation	5.7707027	116.3068
19 Armor	7.8878635	177.57066
21 Engineer	6.0231867	120.29456
25 Communications	6.4263967	133.65964
31 Military Police	8.3647835	189.66032
35 Intelligence	7.0567826	151.08802
42 Adjutant General	6.2905104	128.49343
63 Mech. Maintenance	6.0781448	123.41518
68 Medical	6.7519512	142.00071
74 CBRN	5.7097264	112.44768
88 Transportation	4.3373736	79.807659
92 Supply And Services	7.0411182	150.41651

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C. ESTIMATION

We can use our activation rule to compute the expected values of $ACOL_T$, S_{T1}, and S_{T2} for any reservist in any given year with any given history. The probability of a reservist staying in service in year t is

$$prob(stay) = prob(U'_T(t,i) + \varepsilon > 0)$$

Thus,

$$prob(stay) = \Lambda(\alpha_0 + \alpha_m ACOL_T + \alpha_1 S_{T1} + \alpha_2 S_{T2})$$

where $\Lambda(\ )$ designates the cumulative distribution function of the logistic distribution. This formulation allows the parameters of the utility function to be estimated using a mixed effects logistic regression.[2] We estimate the depreciation parameter κ by running a series of these logit models for a grid of S_{T1} and S_{T2} values derived from a set of possible κ values between zero and one. The logit with the highest likelihood is the estimator of all of our parameters.

The results of our estimation are listed in Table A-2. All parameters are significantly different from zero at better than 99 percent confidence. Our estimate of κ is 1. The parameter α_m is positive, indicating that people value money income as expected. The value of μ is negative but less than α_1. This means that the average reservist has a positive attitude to some level of active duty. [3]

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[2] The estimation of such a model is described in StataCorp LP (2007).

[3] Due to the standardized nature of military pay, the variable ACOL had little variation beyond that which was determined by the level of expected active duty. Consequently, it functioned in the estimation more as an additional measure of active duty than a measure of pay. In order to get a clean estimate of the effect of additional pays and bonuses on continuation, we replaced ACOL with the annualized value of a payment that was relatively uncorrelated with expected active duty: anniversary payments of enlistment bonuses. As a result, the estimated coefficients on our measures of active duty incorporate the ameliorative effects of rising ACOL upon continuation as active duty rises.

Table A-2. Estimation Results

Variable	Estimated Value	Standard Error
α_0	-15.362315	0.0484006
α_m	0.0023271	0.0001308
α_1	0.1498456	0.0041016
μ	-0.0051616	0.00001884
σ	0.0051687	0.0036594

D. ACCESSION

We assume that the parameter α_2 varies across 18-year-old males in the national population according to a skew-normal distribution. We designate the location, scale and shape parameters of this distribution as ξ, ω and γ.

An individual faces three choices: join the Active Army, join the Reserve Components, or remain a civilian. Joining the active Army will result in a value of annualized active duty S_{T1}^A, determined by serving 12 months per year. Joining the reserves will give an expected annualized active duty S_{T1}^R, determined by the activation rule. The individual will join the active Army if the lifetime utility from doing so is greater than zero,

$$\alpha_0^A + \alpha_m ACOL_{T0}^A + \alpha_1 S_{T1}^A + \alpha_2 S_{T2}^A + \varphi^A > 0$$

and the lifetime utility from joining the active Army is greater than that from joining the reserves:

$$\alpha_0^A + \alpha_m ACOL_T^A + \alpha_1 S_{T1}^A + \alpha_2 S_{T2}^A + \varphi^A > \alpha_0^R + \alpha_m ACOL_T^R + \alpha_1 S_{T1}^R + \alpha_2 S_{T2}^R + \varphi^R.$$

The variables φ^A and φ^R are mean-zero normally distributed random errors with standard deviations σ_φ^A and σ_φ^R. The individual will join the reserves if the lifetime utility from joining the reserves is greater than zero,

$$\alpha_0^R + \alpha_m ACOL_{T0}^R + \alpha_1 S_{T1}^R + \alpha_2 S_{T2}^R + \varphi^R > 0$$

and the lifetime utility from joining the reserves is greater than that from joining the actives:

$$\alpha_0^R + \alpha_m ACOL_T^R + \alpha_1 S_{T1}^R + \alpha_2 S_{T2}^R + \varphi^R > \alpha_0^A + \alpha_m ACOL_T^A + \alpha_1 S_{T1}^A + \alpha_2 S_{T2}^A + \varphi^A.$$

We choose the accession parameters α_0^A, α_0^R, σ_φ^A, ξ, ω, γ and σ_φ^R to best approximate the known population proportions of those joining the Active and Reserve Components and the parameters of the reserve population that we previously estimated, μ and σ. In order to choose the accession parameters, we conduct a stochastic search. We take 30,000 random combinations of the accession parameters and use each combination to predict proportions joining and reserve population parameters. The combination that minimizes the squared deviations of these parameters from their known values is taken as our estimate of the accession parameters.

Our results are tabulated in Table A-3. The values of ξ and γ are highly negative, This indicates that a large majority of the population is highly disinclined to serve in the Army.

Table A-3. Tabulated Results

Variable	Value
α_0^A	-37.7677
α_0^R	6.0602
ξ	-0.1553
ω	0.1128
γ	-1.1138
σ_φ^A	0.9431
σ_φ^R	0.1276

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14. ABSTRACT
This paper examines how policies on mobilization, personnel management, and compensation affect the decision to join the Army Reserve Components and the decision to continue in service. We derive and estimate a behavioral model of these decisions, which may be employed to predict the manpower consequences of alternative policies. Our results indicate that while the great majority of the population of young men is disinclined to serve in a mobilized condition, an important minority will perceive mobilizations positively. Accessions and continuation rates are sensitive to the frequency and duration of active duty. Plausible increases in expected active duty will result in relatively small reductions in continuation rates. Pay and bonuses have the capacity to reverse these losses. By contrast, accession rates will increase with reasonable increases in demand for active-duty time above current levels.

15. SUBJECT TERMS
Army Reserve, Reserve Components, Army National Guard, Activation, Mobilization, Recruiting, Retention, Accession, Continuation

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